

NATURAL GROUND CONSOLIDATING METHOD

Patent Number: JP5272126
Publication date: 1993-10-19
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Requested Patent: ☐ JP5272126
Application Number: JP19920094768 19920321
Priority Number(s):
IPC Classification: E02D3/12 ; E21D20/00
EC Classification:
Equivalents:

Abstract

PURPOSE: To consolidate and improve the natural ground by correctly injecting, foaming, and hardening the urethane foam resin having the quick hardening speed over the whole drilled hole of the natural ground via the simple work.

CONSTITUTION: A hollow rod 1 provided with a hole 2 at the tip section is inserted into a drilled hole 23 of the natural ground (b), a short hose 24 is inserted into the mouth of the drilled hole 23, and wastes 26 are packed in it. Urethane foam resin is injected into the mouth of the drilled hole 23 through the hose 24, it is foamed and hardened, and the mouth of the drilled hole 23 is sealed by a urethane foam resin body 27. The urethane foam resin is injected into the whole drilled hole 23 from the hole 2 at the tip section of the rod 1 through the hollow section 2 of the rod 1, and it is foamed and hardened.

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*no exposure of
harmful agents of
ground*

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平5-272126

(43) 公開日 平成5年(1993)10月19日

(51) Int. Cl. ³	識別記号	庁内整理番号	F I	技術表示箇所
E 0 2 D 3/12	1 0 1	9013-2D		
E 2 1 D 20/00	M			

審査請求 未請求 請求項の数1(全 8 頁)

(21) 出願番号 特願平4-94765
(22) 出願日 平成4年(1992)3月21日

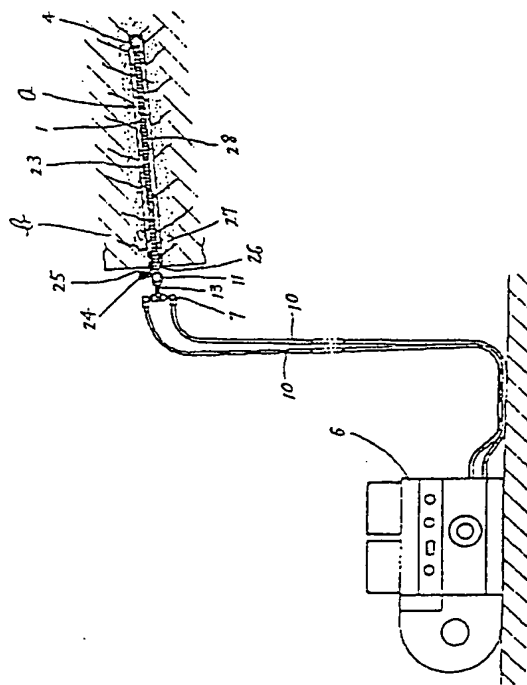
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(54) 【発明の名称】 地山固結工法

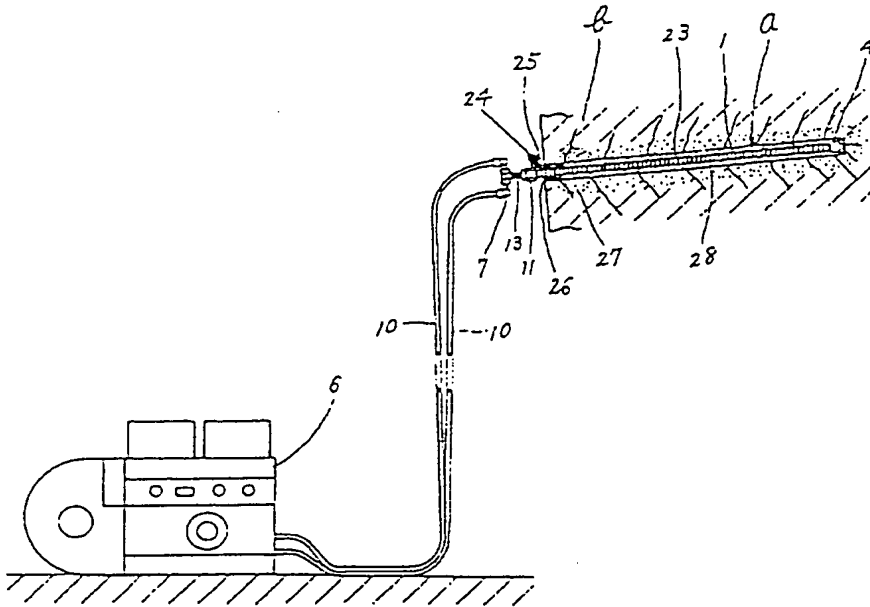
(57) 【要約】

【目的】 簡易に作業し、硬化速度が速い発泡ウレタン樹脂を適量に地山の穿孔内全体にわたって注入し発泡、硬化させて地山を固結改良する。

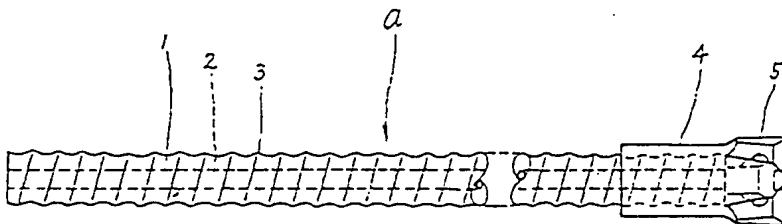
【構成】 先端部に孔(2)を設けた中空のロッド(1)を地山(b)の穿孔(23)内に挿入し、その穿孔(23)の口元内に短いホース(24)を挿入してウエス(26)を詰め、発泡ウレタン樹脂をホース(24)内に通して穿孔(23)の口元内に注入し発泡、硬化させてその発泡ウレタン樹脂体(27)により穿孔(23)の口元を密閉し、その後、発泡ウレタン樹脂をロッド(1)の中空部(2)に通して該ロッド(1)の先端部の孔(2)より穿孔(23)内の全体にわたり注入して発泡、硬化させる。



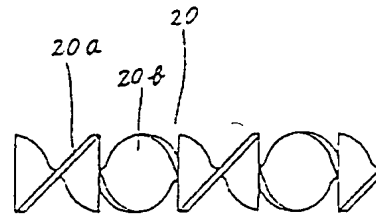
【図1】



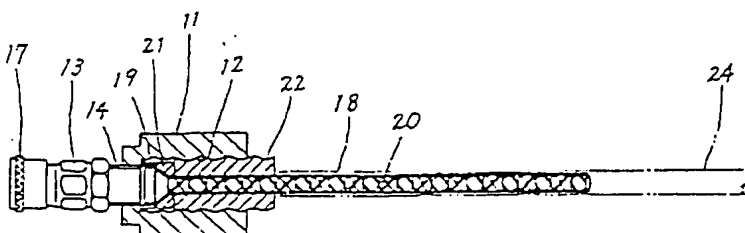
【図2】



【図6】



【図4】



【0036】(4)発泡ウレタン樹脂の硬化速度が数秒乃至十数秒と速いから、その発泡ウレタン樹脂を限定した範囲に注入することができ、材料の浪費を防止する。

【0037】(5)硬化速度が速い発泡ウレタン樹脂を使用すると、湧水のある地山の改良も可能である。

【図面の簡単な説明】

【図1】本発明の一実施態様を示す地山固結工法中の、地山の穿孔内に発泡ウレタン樹脂を注入する状態の説明側断面図で、中間部を切欠して示す。

【図2】同上地山固結工法に使用する自穿孔ロックボルト10の拡大側面図で、中間部を切欠して示す。

【図3】発泡ウレタン樹脂の混合供給部の分解した側面図で、一半部を切断して示す。

【図4】発泡ウレタン樹脂のホースへの混合供給体の側断面図である。

【図5】同上分解斜側面図である。

【図6】その静止混合器の一部の拡大側面図である。

【図7】同上正面図である。

【図8】同上平面図である。

【図9】自穿孔ロックボルトに発泡ウレタン樹脂の混合供給体を取付けた状態の要部の側面図で、一部を切断して示す。

【図10】地山に自穿孔ロックボルトによつて穿孔した状態の側断面図である。

【図11】穿孔の口元内にホースを挿入してウエスを詰めた状態の側断面図である。

【図12】穿孔の口元内に発泡ウレタン樹脂を注入する状態の側断面図である。

【図13】同上ホースの先端部を止め具により閉塞した状態の側断面図である。

【図14】自穿孔ロックボルトに取付カブラー付ねじカブラーを組合した状態の側断面図である。

【図15】穿孔内に発泡ウレタン樹脂を注入する状態の側断面図である。

【図16】注入ポンプの接続口金を取付カブラーより取外した状態の側断面図である。

【図17】本発明の他の実施態様に使用する中空のロッドの側面図で、中間部を切欠して示す。

【図18】地山に穿孔ロッドによつて穿孔した状態の側断面図である。

【図19】穿孔ロッドを抜去つた状態の側断面図であ

る。

【図20】穿孔内に中空のロッドを挿入した状態の側断面図である。

【符号の説明】

a 自穿孔ロックボルト

b 地山

1 ロッド

2 中空部

3 ロープ雄ねじ

4 ビット

5 孔

6 ウレタン注入ポンプ

7 接続口金

8 筒口

9 係止周溝

10 ホース

11 ねじカブラー

12 ロープ雄ねじ

13 取付カブラー

14 雄ねじ

15 逆止弁

16 係止球

17 操作環

18 混合管

19 拡張部

20 静止混合器

20a 1ビット片

20b 1ビット片

21 バッキング

22 ねじ継手

23 穿孔

24 ホース

25 止め具

26 ウエス

27 発泡ウレタン樹脂体

28 発泡ウレタン樹脂体

29 穿孔機のテヤツク

a1 ロッド

30 穿孔ロッド

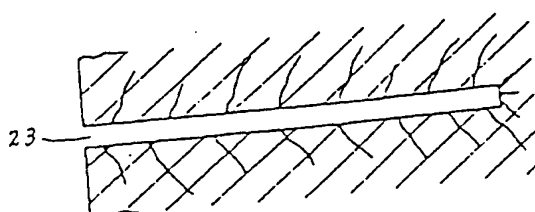
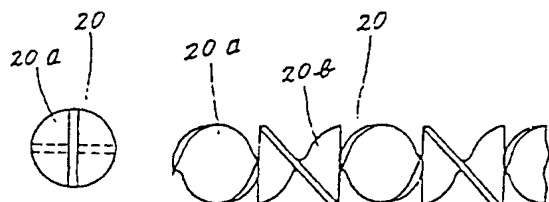
31 ロープ雄ねじ

32 ビット

【図7】

【図8】

【図19】



JP 5-272126 (translation)

[Title of the Invention] CONSOLIDATION PROCESS FOR NATURAL
GROUND

[Abstract]

[Object]

To consolidate and improve natural ground by accurately injecting a urethane foam resin which is easy to work with and quick to harden throughout bore holes of the natural ground, and allowing the urethane foam resin to foam and harden.

[Constitution of the Invention]

A hollow rod (1) provided with a hole (2) in a head end section thereof is inserted in a bore hole (23) of natural ground (b), a short hose (24) is inserted to the mouth of the bore hole (23), a waste cloth (26) is packed in the mouth, a urethane foam resin is allowed to flow in the hose (24) and into the mouth of the bore hole (23) to be foamed and hardened, and the mouth of the bore hole (23) is sealed with a urethane foam resin body (27). The urethane foam resin is then allowed to pass through a hollow section (2) of the rod and injected into the entire bore hole through the hole (2) of the head end section of the rod (1) to be foamed and hardened.

[What is Claimed is:]

[Claim 1]

A consolidation process for natural ground comprising the steps of inserting a hollow rod provided with a hole in a head end section into a bore hole of natural ground, inserting a short hose into a mouth of the

bore hole, packing a waste cloth to seal the mouth, mixing a certain amount of two urethane foam resins having quick hardening speed to pass through the hose, injecting the resin mixture into the mouth of the bore hole to allow it to foam and harden, mixing two urethane foam resins having quick hardening speed to pass the hollow section of the rod, injecting the resin mixture in the entire bore hole from the hole in the head end section of the rod to allow it to foam and harden.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a consolidation process of natural ground for consolidating and improving the natural ground in a limited required area by injecting a urethane-based chemical solution of hard urethane foam resin into the natural ground.

[0002]

[Prior Art]

Conventionally, this kind of consolidation process of natural ground is, as mentioned in Japanese Examined Patent Publication No. 63-63687, to fix a liquid absorbing type base material around the outer circumference of a pipe, impregnate the liquid absorbing type base material with a foaming chemical liquid. Then the pipe with the liquid absorbing type base material is inserted into a hole of natural ground to allow foaming and hardening reactions of the foaming type chemical liquid to form a foamed layer around the pipe, thereby a clearance between the pipe and the natural ground hole wall surface is

filled with the foamed layer and the pipe is fixed inside the hole. Then, a consolidating chemical liquid is allowed to pass through a hollow section of the pipe into the depths of the hole, so that it can be permeated into the natural ground, reacted and hardened, thereby the natural ground around the hole is consolidated.

[0003]

[Problems to be solved by the Invention]

In the above-mentioned conventional consolidation process of the natural ground,

[0004]

(1) Fixing the liquid absorbing type base material to the outer circumference of the pipe is a complicated work.

[0005]

(2) The insertion of the pipe together with the liquid absorbing type base material fixed to the outer circumference in the hole of the natural ground is difficult.

[0006]

(3) The operation takes time and is troublesome because the liquid absorbing type base material around the pipe must be impregnated with the foaming chemical liquid and the pipe with the liquid absorbing type base material must be inserted immediately into the hole of the natural ground.

[0007]

(4) The consolidation of the natural ground is unable to take place precisely since the consolidating chemical liquid is passed

through the hollow section of the pipe into the depths of the hole of natural ground the consolidating chemical liquid the natural ground and permeates only into the depths of the hole to be reacted and hardened, and will not permeate in other sections of the hole.

[0008]

[Means for Solving the Problems]

In the present invention, in order to precisely inject a urethane foam resin which is easy to work with and quick to harden throughout the whole bore hole of natural ground, a hollow rod with a hole provided at a head end section is inserted in a bore hole of natural ground, the mouth of the bore hole is blocked up with a waste cloth after inserting a short hose, a certain amount of two urethane foam resins is mixed to pass through the hose to inject into the mouth to be foamed and hardened. Then two urethane foam resins are mixed and passed through the hollow section of the rod to inject into the entire bore hole from the hole in the head end section of the rod to be foamed and hardened, thereby to consolidate the natural ground. Thus, the injection of the urethane foam resin with quick hardening speed into the entire bore hole of the natural ground is achieved by sealing the mouth of the bore hole in the natural ground with foamed and hardened urethane foam resin, and then further injecting the urethane foam resin into the entire bore hole from the hollow section of the rod through the hole in the head end section of the rod.

[0009]

[Example]

FIGS. 1 through 16 show an embodiment of the present invention. Referring to the drawings, (a) designates a self-boring lock bolt utilizing a hollow rod and (1) designates a rod equipped with a hollow section (2), to the outer circumference of which a rope male thread (3) is provided. (4) designates a bit screwed to a head end section of the rod (1), and holes (5) in free communication with the hollow section (2) of the rod (1) are provided in both sides of the head end.

[0010]

(6) designates a urethane injection pump for separately discharging polyether-based polyol (hereinafter called "liquid A") and modified polyisocyanate (hereinafter called "liquid B") as two liquid urethane foam resins to be mixed, (7) designates an end connector including an engaging circumferential groove (9) formed on an intermediate section of the outer circumference of a central nozzle (8). Openings on both ends of the end connector (7) are connected to a discharge ports for the liquid A and the liquid B of the urethane injection pump (6) with hoses (10) and (10), respectively.

[0011]

(11) designates a screw coupler with a rope female thread (12) provided on the internal circumference thereof. A base end male thread (14) of a mounting coupler (13) is screwed to fix to the center female thread hole of one end wall. A check valve (15) is installed in an intermediate section of the inside of the mounting coupler (13) and an engaging ball (16) is installed at a head end section thereof, so that

the mounting coupler (13) equipped with the screw coupler (11) can be attached and detached instantaneously by engaging or disengaging the engaging ball (16) with the engaging circumferential groove (9) of the nozzle (8) by an operating ring (17) mounted to the outer head end section of the mounting coupler (13).

[0012]

(18) shows a mixing pipe provided with a flared base section in the form of trumpet, which accommodates therein a stationary mixer (20) composed of a large number of 1-pitch pieces (20a) of left-thread screw and a large number of 1-pitch pieces (20b) of right-thread screw alternately formed in an orthogonal state. (21) shows a funnellform packing made of rubber, etc. and (22) shows a screw joint which is fabricated by cutting a hollow rope thread rod same as the rod (1) into an appropriate short size.

[0013]

(b) shows natural ground, (23) is a bore hole provided in the natural ground (b), (24) is a short hose, (25) is a head end fastener of the hose (24), (26) is a waste cloth, (27) is a urethane foam resin body that has been foamed and hardened at the mouth of the bore hole (23), (28) is a urethane foam resin body that has been foamed and hardened throughout the bore hole (23), and (29) is a chuck of a boring machine.

[0014]

The execution procedure is described as follows.

[0015]

(1) First of all, as shown in FIG. 4, the packing (21) and the

screw joint (22) are fitted successively to the base section of the mixing pipe (18), and the screw joint (22) is screwed into the rope female thread (12) of the screw coupler (11) equipped with the mounting coupler (13) to fix them integrally.

[0016]

(2) As shown in FIG. 10, the chuck (29) of the boring machine is screwed to fit to the base section of the rod (1) of the lock bolt (a), and the bore (23) is formed in a specified depth by the lock bolt (a) in the natural ground (b).

[0017]

(3) As shown in FIG. 11, the chuck (29) of the boring machine is detached from the lock bolt (a). Then, after inserting the hose (24) into the mouth of the bore hole (23), the waste cloth (26) is packed to block the mouth.

[0018]

(4) After the mixing pipe (18) integrated with the mounting coupler (13), etc. as shown in FIG. 4 is inserted into the hose (24) as shown in FIG. 12, the nozzle (8) of the end connector (7) is inserted in the mounting coupler (13), and the engaging ball (16) is fixed into the engaging circumferential groove (9) by the operating ring (17), and the mounting coupler (13) is connected to the end connector (7).

[0019]

(5) By the use of the injection pump (6), specified amounts of liquid A and liquid B are introduced into the hoses (10) and (10), respectively, at a suitable ratio. The liquid A and the liquid B are joined

in the end connector (7) and injected in the inner vicinity of the waste cloth (26) at the mouth of the bore hole (23) from the head end of the hose (24) via the nozzle (8) of the end connector (7), the mounting coupler (13), the mixing pipe (18), and the hose (24). In such event, the liquid A and the liquid B are mixed by repeating left turns and right turns many times by guidance of the alternately formed left-thread screw 1-pitch pieces (20a) and the right-thread screw 1-pitch pieces (20b) when they pass inside the mixing pipe (18), and the mixture liquid is injected.

[0020]

(6) The mixing pipe (18) is drawn out of the hose (24), and as shown in FIG. 13, the outer head end section of the hose (24) is bent and fixed with the fastener (25), and the operating ring (17) is operated to remove the mounting coupler (13) equipped with the mixing pipe (18) from the end connector (7). Then, the mixture liquid of the liquid A and the liquid B passes in the hose (24) without leaking and foams and hardens in a short period of time, about a few to ten-odd seconds after injection. Thus, the urethane foam resin body (27) is formed in the inner vicinity of the waste cloth (26) at the mouth of the bore hole (23) to seal the mouth of the bore hole (23) as shown in FIG. 13.

[0021]

(7) After inserting the mixing pipe (18) equipped with the packing (21) into the hollow section (2) of the rod (1) of the lock bolt (a) as shown in FIG. 9, the rope female thread (12) of the screw coupler (11) equipped with the mounting coupler (13) is screw-fitted to the base

section of the rope male thread (3) of the rod (1) to mount the screw coupler (11) equipped with the mounting coupler (13) to the lock bolt (a) as shown in FIG. 14.

[0022]

(8) The end connector (7) is connected to the mounting coupler (13) as shown in FIG. 15 by operating in the same manner as the above to inject the liquid A and the liquid B at a proper ratio into the hoses (10) and (10), respectively, by the injection pump (6). When the injection pressure is increased to a certain level, the injection operation by the injection pump (6) is stopped. Then, the liquid A and the liquid B are mixed when they pass the mixing pipe (18) from the hoses (10) and (10) via the mounting coupler (13), and the mixture liquid is injected into the depths of the bore hole (23) from the hole (5) via the hollow section (2) of the lock bolt (a) to fill the entire bore hole (23).

[0023]

(9) Thereafter, as shown in FIG. 16, the end connector (7) is detached from the mounting coupler (13). The mixture liquid of the liquid A and the liquid B does not leak out of the mounting coupler (13) owing to the check valve (15) in the mounting coupler (13), and foams and hardens in a short time, about a few to ten-odd seconds after injection. Thus, the urethane foam resin body (28) is formed throughout the bore hole (23) to consolidate the natural ground.

[0024]

Table 1 shows the properties of the liquid A and the liquid B to be injected in the mouth of the bore hole (23) and the inside of the bore

hole (23).

[Table 1]

		OKR	OKP	OKC
Features		Instantaneously consolidating type	Permeating type	For calking
Applied natural ground		Springs and cold districts	Sandy soil and fissured natural ground	Mouth blocking, etc.
Liquid properties	Liquid A	Faint yellow transparent liquid		
	Liquid B	Dark brown liquid		
Main component	Liquid A	Polyether based polyol		
	Liquid B	Modified polyisocyanate		
Liquid viscosity at 20°C	Liquid A (18 kg/can)	250 ± 40 cps	80 ± 20 cps	600 ± 50 cps
	Liquid B (20 kg/can)	250 ± 40 cps	80 ± 20 cps	250 ± 50 cps
Liquid specific gravity	Liquid A	1.09	1.10	1.09
	Liquid B	1.23	1.22	1.23
Composition ratio (by volume) Liquid A : liquid B		1:1	1:1	1:1
20°C rise time		12 ± 3	60 ± 10	120 ± 10
Expansion ratio (free foaming)		15	10	4

[0025]

FIGs. 17 through 20 show another embodiment using a pipe rod in place of the self-boring lock bolt (a) in the above-mentioned embodiment according to the present invention. Referring to drawings, (a1) shows a hollow rod and (1a) shows a rod body of the pipe provided with a hollow section (2). A rope male thread (3) is provided on the outer circumference of a base section of the rod, a few holes (5a) are bored in a head end section, and a conical metal tip (4a) is fitted to the head end of the rod body (1a).

[0026]

(30) designates a boring rod including a rope male thread (31)

provided on the outer circumference of a base section thereof and a bit (32) mounted on the head end thereof. Other reference characters are the same as shown in FIGs. 1 through 16.

[0027]

The execution procedure is described as follows.

[0028]

(1) As shown in FIG. 18, the chuck (29) of a boring machine is screwed to the base section of the boring rod (30), and the bore hole (23) is formed in a specified depth with the boring rod (30) in the natural ground (b).

[0029]

(2) As shown in FIG. 19, the boring rod (30) is drawn out of the bore hole (23).

[0030]

(3) As shown in FIG. 20, a rod (a1) is inserted in the bore hole (23).

[0031]

(4) Thereafter, the execution procedure of the above embodiment shown in FIG. 11 through FIG. 16 is carried out, and thus the natural ground is consolidated with the urethane foam resin bodies (27) and (28).

[0032]

[Effect of the Invention]

The consolidation process for natural ground according to the present invention has the following advantages.

[0033]

(1) A hollow rod is inserted in a bore hole, and then a short hose is inserted in the mouth of the bore hole and a waste cloth is packed to block up the mouth, and thereafter a urethane foam resin is allowed to pass through the hose into the mouth of the bore hole to be foamed and hardened. Therefore, the urethane foam resin can be injected easily and smoothly only to the bore hole mouth, and thus the bore hole mouth can be securely sealed with the urethane foam resin body.

[0034]

(2) After the bore hole mouth is sealed with the urethane foam resin body, the urethane foam resin is further allowed to pass through the hollow section of the rod to be injected into the whole area of the bore hole from the holes at the head end section. Therefore, the urethane foam resin can be injected quickly and satisfactorily into the inside of the bore hole from the hollow section of the rod and foamed and hardened without leaking from the bore hole mouth. Thus, the resin can press-seal the natural ground in the whole bore hole.

[0035]

(3) In the natural ground with many fissures or the poor ground of sandy soil, etc., the urethane foam resin permeates in narrow fissures or sandy soil because the liquid viscosity of the urethane foam resin to be injected is low, and then foams and consolidates the ground. Further, since the urethane foam resin provides adhesion to the natural ground, it can bind and improve the natural ground.

[0036]

(4) Since the hardening speed of the urethane foam resin is as quick as a few to ten-odd seconds, it is possible to inject the urethane foam resin to a limited range, and thus waste of the materials can be prevented.

[0037]

(5) If a urethane foam resin which hardens faster is used, the natural ground with spring can also be improved.

[Brief Description of the Drawings]

[FIG. 1]

A sectional side view partly broken away, in which a urethane foam resin is injected in a bore hole of natural ground according to an embodiment of a consolidation process of natural ground of the present invention;

[FIG. 2]

An enlarged side view partly broken away, showing a self-boring lock bolt used for the consolidation process of natural ground;

[FIG. 3]

A sectional side view partly broken away, showing a section for mixing and supplying the urethane foam resin in a separate state;

[FIG. 4]

A sectional side view of a section for mixing and supplying the urethane foam resin to a hose;

[FIG. 5]

A perspective view of the above section in a separate state;

[FIG. 6]

An enlarged side view of a part of a stationary mixer;

[FIG. 7]

A front view of the stationary mixer;

[FIG. 8]

A plan view of the stationary mixer;

[FIG. 9]

A side view partly broken away, showing a main part of the section for mixing and supplying the urethane foam resin mounted to a self-boring lock bolt;

[FIG. 10]

A sectional side view in which a bore hole is formed in the natural ground by the self-boring lock bolt;

[FIG. 11]

A sectional side view in which a hose is inserted into the bore hole mouth and a waste cloth is packed therein;

[FIG. 12]

A sectional side view showing the condition in which the urethane foam resin is injected into the mouth of bore hole;

[FIG. 13]

A sectional side view in which a head end section of the hose is blocked with a fastener;

[FIG. 14]

A sectional side view in which a screw coupler equipped with a mounting coupler is screwed to the self-boring lock bolt;

[FIG. 15]

A sectional side view in which the urethane foam resin is injected into the bore hole;

[FIG. 16]

A sectional side view in which an end connector of an injection pump is detached from the mounting coupler;

[FIG. 17]

A side view partly broken away, showing a hollow rod used in another embodiment of the present invention;

[FIG. 18]

A sectional side view in which a bore hole is formed in natural ground by a boring rod;

[FIG. 19]

A sectional side view in which the boring rod is removed; and

[FIG. 20]

A sectional side view in which the hollow rod is inserted in the bore hole.

[Description of Symbols]

- a. Self-boring lock bolt
- b. Natural ground
- 1. Rod
- 2. Hollow section
- 3. Rope male thread
- 4. Bit
- 5. Hole
- 6. Urethane injection pump

7. End connector
8. Nozzle
9. Engaging circumferential groove
10. Hose
11. Screw coupler
12. Rope female thread
13. Mounting coupler
14. Male thread
15. Check valve
16. Engaging ball
17. Operation ring
18. Mixing pipe
19. Flared section
20. Stationary mixer
- 20a. 1-pitch piece
- 20b. 1-pitch piece
21. Packing
22. Screw joint
23. Bore hole
24. Hose
25. Fastener
26. Waste cloth
27. Urethane foam resin body
28. Urethane foam resin body
29. Chuck of boring machine

a1. Rod

30. Boring rod

31. Rope male thread

32. Bit

FIG. 1

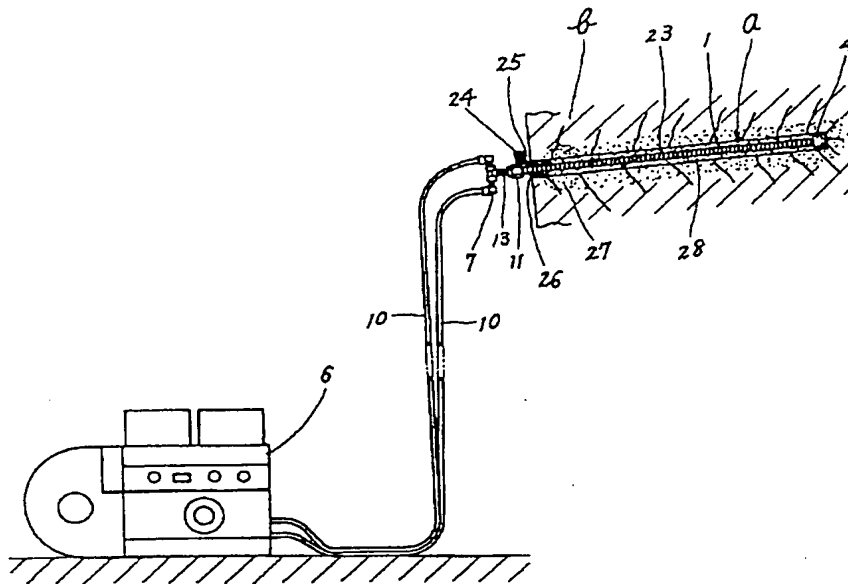


FIG. 2

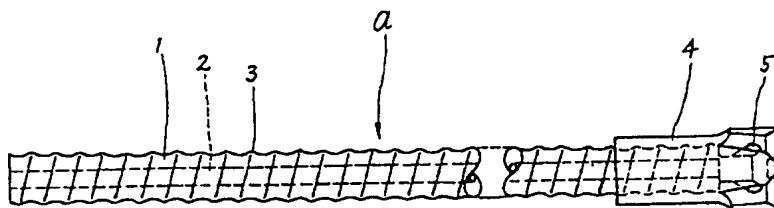


FIG. 6

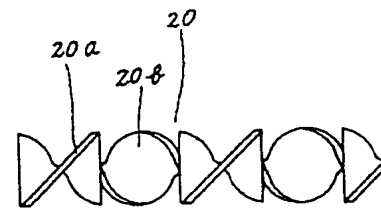


FIG. 4

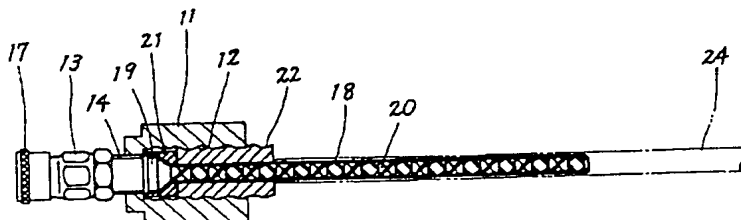


FIG. 3

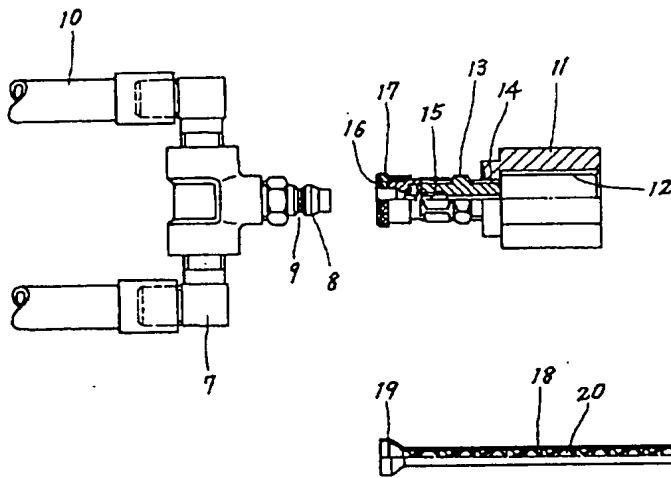


FIG. 5

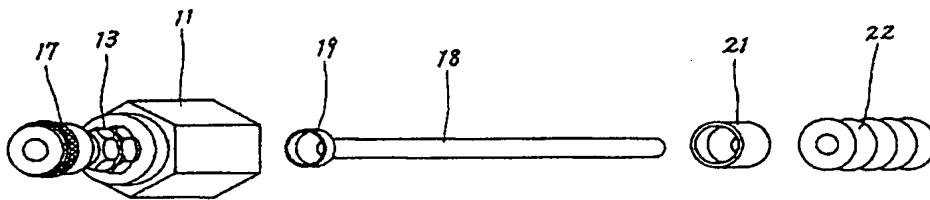


FIG. 9

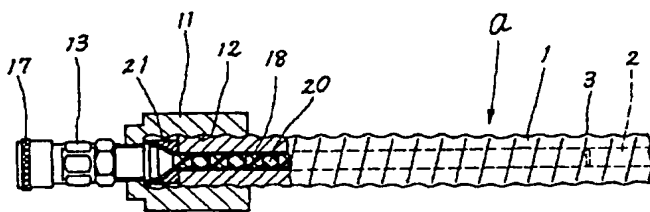


FIG. 10

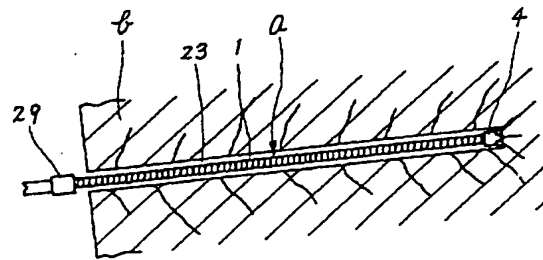


FIG. 11

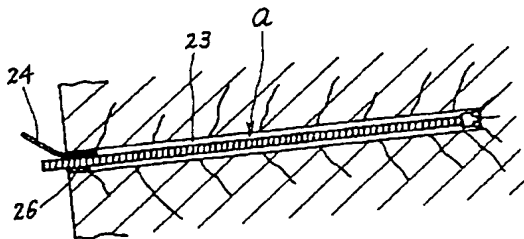


FIG. 12

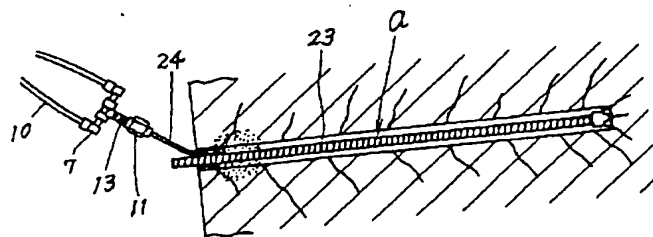


FIG. 13

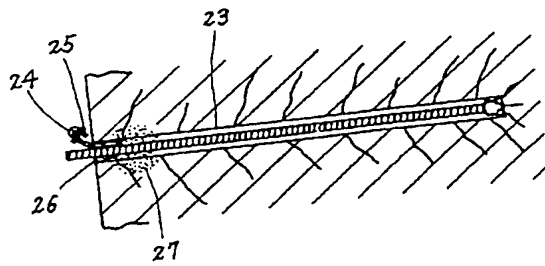


FIG. 14

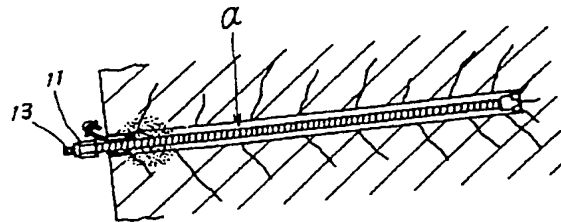


FIG. 15

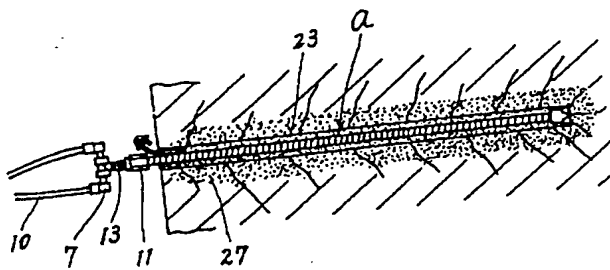


FIG. 16

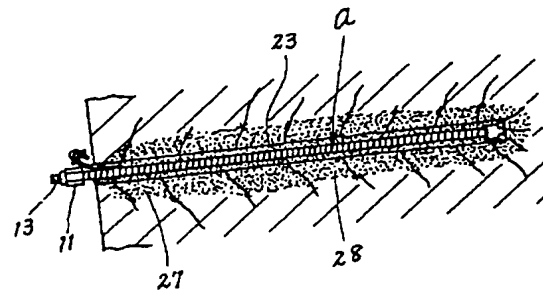


FIG. 17

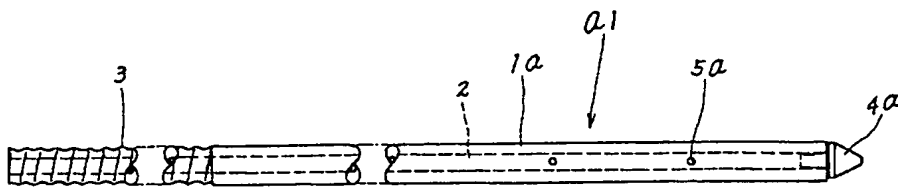


FIG. 18

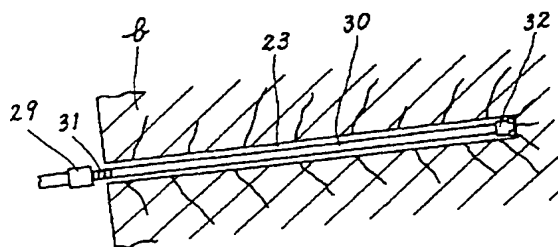


FIG. 20

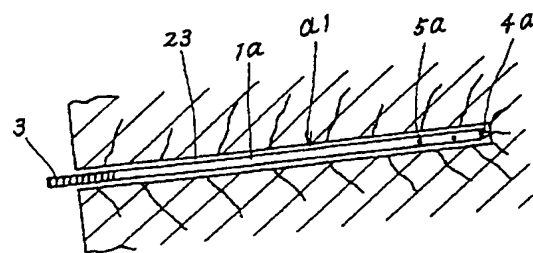


FIG. 7

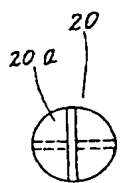


FIG. 8

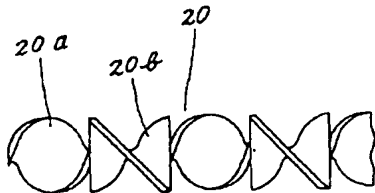


FIG. 19

